CLAIMS

What is claimed is:

1. A method for operating a Voice over IP capable device that is coupled to a packet network, comprising:

receiving and buffering data packets that comprise voice information;

decoding the voice information to obtain voice samples; and

buffering the decoded voice samples prior to generating a voice play-out signal, where

the decoded voice samples are time scaled as a function of packet network conditions to adjust a Buffering Delay to enable changing the voice play-out rate to provide a substantially continuous output voice signal when the data packets are received at a rate that differs from a rate at which the data packets are created.

2. A method as in claim 1, comprising a substantially asynchronous component that determines data packet arrival delays, and a substantially synchronous component that is responsive to the operation of the asynchronous component to control the Buffering Delay based on Time Scaling of the decoded voice samples.

3. A method as in claim 1, where the Buffering Delay of a packet buffer is a time period that a packet resides in the packet buffer before play-out of the first frame of the packet.

4. A method as in claim 3, further comprising revising estimates of at least packet interruption delay average and mean deviation, packet arrival interval average, Buffering Delay average and mean deviation.

5. A method as in claim 3, further comprising measuring the Buffering Delay as being equal to a Virtual Play-out Point plus a packet creation interval times (an incoming

packet's sequence number less a first packet's sequence number), less the incoming packet's arrival time

6. A method as in claim 3, further comprising measuring the Buffering Delay as being a function of a Virtual Play-out Point, which is a Play-out Point that should have been used for the first packet of a voice session, if the remainder of the packets would have been played out at a steady rate, while still resulting in the same end-to-end delay as with an actual non-steady play-out of packets.

7. A method as in claim 6, where when the decoded voice samples are time scaled, or a received packet buffer underflows or overflows, the Virtual Play-out Point is changed correspondingly.

8. A method as in claim 1, where decoding includes detecting a type of received voice frame as being one of a bad frame, no frame, or a good frame, and where Time Scaling is performed only if the type of the received voice frame is detected as being a good frame.

9. A Voice over IP capable device that is coupled to a packet network, comprising:

a receiver for receiving and buffering data packets that comprise voice information;

a decoder for decoding the voice information to obtain voice samples;

a buffer for buffering the decoded voice samples prior to generating a voice play-out signal, further comprising

a time scaling function interposed between said decoder and said buffer for time scaling decoded voice samples as a function of packet network conditions to adjust a Buffering Delay to enable changing the voice play-out rate to provide a substantially continuous output voice signal when the data packets are received at a rate that differs from a rate at which the data packets are created.

10. A device as in claim 9, comprising a substantially asynchronous component that determines data packet arrival delays, and a substantially synchronous component that is responsive to the operation of the asynchronous component to control the Buffering Delay based on Time Scaling of the decoded voice samples.

11. A device as in claim 9, where a Buffering Delay of a received packet buffer is a time period that a packet resides in the packet buffer before play-out of the first frame of the packet.

12. A device as in claim 11, further comprising means for revising estimates of at least packet interruption delay average and mean deviation, packet arrival interval average, Buffering Delay average and mean deviation.

13. A device as in claim 11, further comprising means for estimating the Buffering Delay as being equal to a Virtual Play-out Point plus a packet creation interval times (an incoming packet's sequence number less a first packet's sequence number), less the incoming packet's arrival time

14. A device as in claim 11, further comprising means for estimating the Buffering Delay as being a function of a Virtual Play-out Point, which is a Play-out Point that should have been used for the first packet of a voice session, if the remainder of the packets would have been played out at a steady rate, while still resulting in the same end-to-end delay as with an actual non-steady play-out of packets.

15. A device as in claim 14, where when the decoded voice samples are time scaled, or a packet buffer underflows or overflows, the virtual play-out point is changed correspondingly.

16. A device as in claim 9, where said decoder comprises means for detecting a type of received voice frame as being one of a bad frame, no frame, or a good frame, and where said Time Scaling function operates only if the received voice frame is detected as being a good frame.

17. A computer program embodied on a computer readable medium for directing a data processor to operate a device that is coupled to a packet switched network, comprising:

program code to receive and buffer data packets that comprise time-ordered content that is intended to be presented to a user in a substantially continuous and substantially uniform temporal sequence;

program code to decode the content to obtain samples for use in making a presentation to the user during a sample play-out period; and

program code, responsive to packet network conditions, to time scale samples for enabling changing a play-out rate to provide a substantially continuous and uniform presentation when the data packets are received at a rate that differs from a rate at which the data packets are created.

18. A computer program as in claim 17, comprising a substantially asynchronous component that determines data packet arrival delays, and a substantially synchronous component that is responsive to the operation of the asynchronous component to control packet buffering delay based on the time scaling.

19. A computer program as in claim 17, where said time-ordered content comprises a voice signal, and where samples are time scaled by one of deleting or reproducing samples, as a function of whether data packets are arriving faster or slower, respectively, than the rate at which the data packets are created.

20. A computer program as in claim 17, where said time-ordered content comprises a video signal, and where samples are time scaled by one of deleting or inserting video frames or samples, as a function of whether data packets are arriving faster or slower, respectively, than the rate at which the data packets are created.

21. A computer program as in claim 20, where video and audio are controlled separately and are synchronized by maintaining a virtual play-out point for each time synchronized.

22. A computer program as in claim 17, further comprising program code to measure a delay for each arriving packet and, if there is an interruption in the arrival of one or more packets, said program code updates at least a Buffering Delay value, a Virtual Play-out Point value, and an Interruption Delay value.

23. A computer program as in claim 17, where a Buffering Delay value is set to zero when a first packet arrives, and further comprising program code to update a Buffering Delay Average value and, using the updated Buffering Delay Average value, a Buffering Delay Mean Deviation value.

24. A computer program as in claim 17, further comprising program code to measure a delay for each arriving packet and, if an interruption in packet arrival is detected, said program code updates at least an Interruption Delay average value using exponential averaging, and if an interruption in packet arrival is not detected, said program code updates at least an Arrival Interval Average value using exponential averaging.

25. A computer program as in claim 17, where said device comprises a receiver for coupling to the packet switched network through a wireless link.

26. A computer program as in claim 17, where said device comprises a receiver for coupling to the packet switched network through a wired link.

27. A computer program as in claim 17, where said device comprises a cellular telephone having an RF receiver for coupling wirelessly to the packet switched network.

28. A method for operating a device that is coupled to a packet network, comprising:

receiving and buffering data packets that comprise information that is representative of time-ordered content that is intended to be presented to a person in a substantially continuous and substantially uniform temporal sequence;

decoding the information to obtain samples; and

buffering the samples prior to generating a play-out signal, where

the samples are time scaled as a function of packet network conditions to adjust a Buffering Delay to enable changing the play-out rate to provide a substantially continuous output signal when the data packets are received at a rate that differs from a rate at which the data packets are created.

29. A method as in claim 28, comprising a substantially asynchronous component that determines data packet arrival delays, and a substantially synchronous component that is responsive to the operation of the asynchronous component to control the Buffering Delay based on Time Scaling of the decoded samples.

30. A method as in claim 28, where the time-ordered content comprises a voice signal, and where samples are time scaled by one of deleting or reproducing samples, as a function of whether data packets are arriving faster or slower, respectively, than the rate at which the data packets are created.

31. A method as in claim 28, where the time-ordered content comprises a video signal, and where samples are time scaled by one of deleting or inserting video frames or samples, as a function of whether data packets are arriving faster or slower, respectively, than the rate at which the data packets are created.

32. A device comprising an interface for coupling to a packet network, comprising:

a receiver for data packets that comprise information that is representative of time-ordered content that is intended to be presented to a person in a substantially continuous and substantially uniform temporal sequence;

a decoder to decode the information to obtain samples;

a buffer for storing the samples prior to generating a play-out signal; and

a scaler for time scaling samples as a function of packet network conditions to adjust a Buffering Delay to enable changing the play-out rate to provide a substantially continuous output signal when the data packets are received at a rate that differs from a rate at which the data packets are created.

33. A device as in claim 32, where said device comprises a substantially asynchronous component that determines data packet arrival delays, and a substantially synchronous component that is responsive to the operation of the asynchronous component to control the Buffering Delay based on Time Scaling of the decoded samples.

34. A device as in claim 32, where the time-ordered content comprises a voice signal, and where samples are time scaled by one of deleting or reproducing samples, as a function of whether data packets are arriving faster or slower, respectively, than the rate at which the data packets are created.

35. A device as in claim 32, where the time-ordered content comprises a video signal, and where samples are time scaled by one of deleting or inserting video frames or samples, as a function of whether data packets are arriving faster or slower, respectively, than the rate at which the data packets are created.